REMARKS

Claims 1-21, 23, and 25-34 will be pending upon entry of the present amendment. Claims 1, 11, 21 and 30 are being amended. Claims 22 and 24 were previously canceled. Claim 34 is new. Claims 21, 23, and 25-29 were allowed.

The applicants appreciate the indication that claims 30-33 are directed to allowable subject matter. Claim 30 is being placed in independent form, and thus, is in condition for allowance. Claim 31 and new claim 34 depend on claim 30, and thus, are also in condition for allowance. Claims 32-33 continue to depend on claim 11, which is believed to be in condition for allowance for the reasons expressed below.

One embodiment of the present invention is directed to a process of manufacturing an integrated device that includes a contact structure formed in a through opening of an insulating layer. Prior art methods typically deposit into the through opening a barrier layer, such as titanium, then fill the through opening with a conductive material, such as tungsten or polysilicon, and then deposit a metal layer (Metal 2) on the contact formed by the conductive fill layer. A major problem with such tungsten or polysilicon contacts occurs if they are employed with ferroelectric capacitors that form part of memory cells. That is because such ferroelectric capacitors are processed at high temperature in the presence of oxygen, which degrades the tungsten or polysilicon and can even cause explosions of the tungsten contacts.

The inventors discovered that the problems associated with tungsten or polysilicon contacts could be avoided simply by not filling the through openings with tungsten, polysilicon, or any other filling material. Instead, the inventors discovered that the contacts can be made solely by the titanium-based barrier layer surrounding an empty region. That is, the Metal 2 layer is non-conformally deposited directly on a top portion of the titanium-based barrier layer to close the empty region and directly contact the barrier layer.

Claims 1-2, 5, 11-12, 15, and 21-23 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 6,436,829 to Layadi et al. ("Layadi").

Layadi does not disclose the invention recited in claim 1, as amended. Amended claim 1 recites a process that includes:

depositing a conductive material layer in a manner that simultaneously forms an empty region that is delimited by the conductive material layer and is open at a top end opposite to the bottom of said through opening; and

without previously depositing a filling material in the empty region, forming a second conductive region that closes the top end of the empty region and delimits, together with the contact structure, the empty region.

Layadi does not disclose the above-quoted steps of amended claim 1. Instead, Layadi deposits, in the contact opening 210, titanium/titanium nitride layers 214, 215 and a tungsten plug 230 with a seam 233 that is completely closed as shown in Figure 2. Layadi then performs two CMP processes as shown in Figures 3 and 4 that forms a seam 333 that does not appear to be fully closed in Figure 4. As such, the seam with the open top end 333 in Layadi is not formed simultaneously with depositing the tungsten plug 230, and thus, the Layadi process does not satisfy the language of claim 1.

The deposition of the titanium/titanium nitride layers 214, 215 cannot satisfy the regarding the depositing of a conductive material layer, because Layadi would not satisfy the language of claim 1 calling for forming a second conductive region without previously depositing a filling material in the empty region. Rather than forming a metal trace 560 directly on the titanium/titanium nitride layers 214, 215 and closing an open-ended empty region, Layadi specifies that a "blanket deposition of tungsten fills the remaining void of the contact opening 210 forming tungsten plug 230 (col. 4, lines 20-23). Thus, Layadi does not disclose forming a second conductive region that closes the top end of an empty region delimited by the titanium/titanium nitride layers 214, 215 **without previously depositing a filling material in the empty region**.

For the foregoing reasons, amended claim 1 is not anticipated by Layadi.

Claims 2 and 5 depend on claim 1, and thus, are also not anticipated or rendered obvious by Layadi.

Although the language of amended claims 11-12 and 15 is not identical to that of claim 1, the allowability of claims 11-12 and 15 will be apparent in view of the above discussion.

Claim 8 was rejected under 35 U.S.C. § 103 as being unpatentable over Layadi.

Layadi does not teach or suggest the invention recited in claim 8, which depends on amended claim 1. As discussed above, Layadi does not disclose depositing a conductive material layer in a manner that simultaneously forms an empty region that is delimited by the conductive material layer and is open at a top end and closing the empty region without previously depositing a filling material in the empty region. In addition, a person would not be motivated to amend Layadi's process to satisfy the language of claim 1. Layadi's entire purpose is to minimize the formation of voids, such as the seam 233, as much as possible. Thus, there is no motivation to modify Layadi to form a second conductive region that closes the top end of an empty region formed by depositing a conductive material layer in a manner that simultaneously forms the empty region that is open at a top end. Accordingly, claim 8 is nonobvious.

Claims 3-4, 6-7, 13-14, and 16-19 were rejected under 35 U.S.C. § 103 as being unpatentable over Layadi in view of U.S. Patent No. 6,376,369 to Doan.

Layadi and Doan do not teach or suggest the invention recited in claims 3-4 and 6-7, which depend on claim 1. As discussed above, Layadi does not teach the steps of simultaneously forming an open-ended empty region while depositing a conductive material layer and then forming a second conductive region that closes the top end of the empty region without previously depositing a filling material in the empty region. In addition, Doan does not suggest modifying the process of Layadi to satisfy the language of claim 1. Instead, like Layadi, Doan deposits a filling material 116 after depositing a barrier layer 114 in an opening. Rather than performing CMP etching as in Layadi, Doan deposits another filling material 118 and then treats the materials 116, 118 form a composite alloy 140 that completely fills the void 112. Thus, rather than forming a second conductive region that closes the top end of the empty region without previously depositing a filling material in the empty region as recited in claim 1, Doan deposits two filling materials 116 and 118. Accordingly, claims 3-4 and 6-7 are nonobvious in view of Layadi and Doan.

Although the language of amended claims 13-14, and 16-19 is not identical to that of claims 3-4 and 6-7, the allowability of claims 13-14, and 16-19 will be apparent in view of the above discussion.

Claims 9-10, and 20 were rejected under 35 U.S.C. § 103 as being unpatentable over EP Publication No. 0793274 to Jones et al. ("Jones") in view of Layadi.

The cited prior art does not teach or suggest the invention recited in claims 9-10, which depend on claim 1. In particular, Jones does not teach or suggest the features of claim 1 that are missing from Layadi. That is, Jones does not teach or suggest the steps of simultaneously forming an open-ended empty region while depositing a conductive material layer and then forming a second conductive region that closes the top end of the empty region without previously depositing a filling material in the empty region. Instead, Jones simply teaches that conductive contacts 63 are formed by conventional processing steps (page 4, lines 54-56). As a result, claims 9-10 are nonobvious in view of the cited prior art.

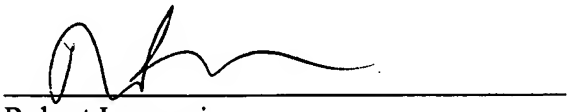
Although the language of claim 20 is not identical to that of claims 9-10, the allowability of claim 20 will be apparent in view of the above discussion.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

SEED Intellectual Property Law Group PLLC



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